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Jonathon Archer  
*George Fox University*

Alison Childs  
*George Fox University*

Sharon Covaciu  
*George Fox University*

Chad DeYoung  
*George Fox University*

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## Effective Instructional Tools or Costly Distractions: An Examination on the Effective Implementation of Technology in the Classroom

*Jonathon Archer<sup>i</sup>*  
*George Fox University*

*Alison Childs*  
*George Fox University*

*Sharon Covaciu*  
*George Fox University*

*Chad DeYoung*  
*George Fox University*

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Technological advances have proliferated in the workplace, our daily lives, and even in the area of research. With each passing day different forms of technology are becoming increasingly available to people all around the world. The quick influx of technology has resulted in little time for technological professional development in the field of education. Although the majority of today's youth have grown up in a technological world, the adults educating these students have little exposure and understanding of these new advances (Christensen & Knezek, 1999).

The influx of technology into today's society has had several ramifications. From the time of infancy, children are immersed in technology. This exposure has led many students to grasp new technologies quickly, whereas for those who did not grow up in this Digital Era, learning new technology may be time consuming. It is widely believed that the frequent use of technology has affected the attention span of today's youth (Swing, Getile, Anderson, & Walsh, 2010). Quickly answering questions using the Internet and talking with friends anywhere are just a couple examples of how technology has resulted in an increased amount of instant gratification. Technology, however, has also helped to increase learning through Gardner's Multiple Intelligences (McKenzie, 2002). Increasing the use of technology in the classroom could also help students to relate their lives to their education. Between the Internet, cell phones and iPods, students are connected with technology almost every waking moment. Why must this stop just because they enter the classroom?

The extensive availability of resources has led many teacher preparation programs to increase technology exposure to their preservice teachers. Teachers in training are learning which technologies are available and being asked to consider how best to integrate these new methods into their classrooms to both connect with and instruct their students. The purpose of our research was to evaluate the difference in student performance between teacher-centered (TC) and student-centered (SC) technology use in classrooms.

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<sup>i</sup> **Mr. Jonathon Archer** may be reached at [jonathon.w.archer@gmail.com](mailto:jonathon.w.archer@gmail.com).

## Literature Review

The 20th century approached with inventions that radically altered education. Electricity paired with photography, soon brought the world into the classroom with films, overhead projectors and eventually sounds (Cuban, 1986). Broadcast television became available to the schools in the 1950s, and in the 1970s videotape was introduced. These devices enabled teachers to bring concepts from outside the students' immediate world into the classroom to share as a community. Technology now influences education in profound ways and the literature reviewed focused on technology in schools, teacher use of technology, and student use of technology. All three areas form the foundation in which we situate this research.

### Technology in Schools

Over time, the variety of technologies such as radio, television, and the Internet have been introduced to schools, each sparking controversy about its appropriateness for schooling and effectiveness as a teaching and learning tool (Snider, 1992). Despite this debate, technology has been an increasingly influential factor in education. Computers and cell phones are used in developed countries both to complement established education practices and develop new ways of learning such as online education (Bacon & Jakovich, 2001).

Recent emphasis on technology integration in education comes from the United States Department of Education through the 'enhancing education through technology' programs (Fletcher, 2003). As technology revolutionizes the way that we interact with each other and the world around us, it is openly acknowledged that students who are to be prepared for life in the 'real world' will need a strong foundation in the use of technology as a tool. Due to the results of studies like *Apple's Classrooms of Tomorrow*, which have shown the advantages of technology in education, schools are increasing their efforts to integrate technology into education (Apple, 2008).

Today teachers use technology such as PowerPoint, SMART Boards and online depositories to deliver course information (Bork, 2000). In spite of the apparent trend toward increasing the usage of more modern forms of technology in the classroom, the confluence of technology in the classroom is being debated within academia (Cuban, Kirkpatrick, & Peck, 2001; Ertmer, 1999). Understanding the relationship between technology and academic performance has taken on new significance as technology use on campuses has expanded. In essence there are two sides to the debate.

On one side of the argument are those who question whether the use of modern technology increases a student's ability to learn and retain more information (Neal, 1998). Some fear the use of technology may lead to the creation of barriers between the student and teacher by fostering an atmosphere not conducive to student-centered interactions (Ertmer, 1999; Hew & Brush, 2007). Others argue that students will become passive and "tune-out" the teacher, thus failing to learn the necessary information (Perkins, 1991). Teachers who adhere to a belief in "learner-centered teaching" as the best method to enhance students' learning also fear that some teachers who turn toward the use of advanced technology will fail to use it effectively, and thereby decrease student

learning. Thus, using technology in the classroom may hinder a student's understanding of course material rather than enhance it (Nickerson, 1995).

On the other side of the argument are those who contend that using modern technology provides both structure to and clarification of material (Pauw, 2002), and these are important to the learning process. Others suggest that the visual component of PowerPoint lends itself even greater value for those students whose learning is improved through the use of visual aids (Brown & Atkins, 1988). There are those who suggest that PowerPoint enhances students' learning by adding variety to the delivery of course material (Bartsch & Cobern, 2003). Teachers who employ various methods of technology integration during classes are able to better keep students' attention, thereby, reducing boredom with the lecture and, consequently improving the overall learning experience.

### **Teacher Use of Technology**

Today, teachers are expected to integrate technology into their classrooms. Often school systems provide workshops introducing various technologies in an attempt to improve technology use in the classroom, only to later find that teachers from those workshops use the technology on a limited basis (Ertmer, Conklin, Lewandowski, Osika, Selo, Wignallet, 2003). The lack of implementation may occur for many reasons. First, teachers may see a demonstration, but may not have the opportunity to use the hardware and software in a hands-on fashion (Cwikla & Morse, 2005; Quinn & Valentine, 2001; Viadero, 1997). As Zehr (1997) argues, “money spent on school technology is wasted without an equal effort to help teachers with its use and integration into the curriculum” (p. 24). Second, technology may not be located in each classroom. If teachers have to make special arrangements to bring the technology into their room, they may lose interest in making it a regular part of their lessons (Middleton, Flores & Knaupp, 1997). Third, many school systems may view technology as superfluous, rather than an effective teaching tool (Oppenheimer, 2003). As Cwikla and Morse (2005) argue, technology should not be viewed simply as an “addition to the curriculum” but rather as a “powerful vehicle for delivering the curriculum” (p. 4).

Teachers may view technology as a way to enhance lesson plans and create a more interactive learning environment, but research shows that technology-assisted learning improves students' acquisition of knowledge (Hui, Hu, Clark, Tan & Milton, 2008). New technologies create additional strategies for reaching different learning styles. Other research has found that “students are more successful in school, are more motivated to learn and have increased self-confidence and self-esteem when technology is present in the educational environment” (SIIA Report, 2000). Frey and Birnbaum's study (2002) found that the majority of students agreed that computer-assisted instruction in class had a positive effect on lectures, especially in helping them take notes and study for exams.

### **Students and Technology**

As reported by Cowan, the role of the computer falls into one of three categories: tutor (teaches student), tool (used for a function), or tutee (performs according to student programming) (2008). Technology had such a strong impact in the world that by about

1980 people were being born into the ‘Net generation’ and are referred to as ‘digital natives’ (Bennett, Maton, & Kervin, 2008). Millennial students handle cell phones, iPods, social networking sites, and other forms of technology on a daily basis. New information is readily available to them within seconds. According to the Corporation for Public Broadcasting, teenager use of digital media has surpassed television watching – 3.5 hours per day versus 3.1 hours per day (Corporation for Public Broadcasting, 2002).

According to Brown (2005), the Net Generation requires a learner-centered model of education with a shift from the traditional teaching paradigm to a constructivist learning structure. As students see relevance in their daily activities, their interest in learning grows (Brooks & Grennon, 1999). In contrast, a more traditional pedagogical approach involves a teacher-centered learning environment. Technology can be integrated within both of these teaching methods; however, one may be more appropriate for different learning styles.

Integration of technology looks very different within these two models. In a SC learning environment, the learners are in control of the tools. They take an active role in their learning and are able to plan, organize, and synthesize subject content (Wu & Huang, 2007). Within a TC environment, technology is limited to teacher use only in order to model or transmit specific information. This does not suggest however, that students are not actively engaged in a traditional teaching approach. The purpose of this study is to research the impact of specific technology integration (teacher-centered vs. student-centered) on student performance, as measured by use of a student perception survey and the analysis of student assessments.

### **Methodology**

The study employed a mixed-methods approach using survey research and student assessment scores. Quantitative and qualitative data were collected through baseline surveys, student perception surveys, and an analysis of classroom assessments. The research was conducted at four public school sites around a Pacific Northwest metropolitan area with over one hundred and fifty students involved in the study. The study began with each student-participant completing a baseline survey about his or her familiarity with various types of technology. The survey also asked students to rank types of technology they thought were most and least useful from a provided list. From that data, each researcher chose types of technology, some student-centered (SC) and some teacher-centered (TC), that were used in the classroom, based on both what the students reported would be beneficial, and what was available at their site. During four different lessons, distinct concepts were taught while integrating either TC or SC technology. After each lesson students took a perception survey that asked four questions about the technology from that day. Responses were rankings on a five-point Likert-type scale. Question one asked students how well they met the daily objective or learning target. Question two asked students to rank their understanding of the material. Questions 3 and 4 asked how well they performed on in-class activities, and if they thought the use of technology helped them understand the material. After four lessons using technology integration, students were assessed on the concept attainment using classroom quizzes or tests. Scores were calculated to find the average proficiency on the concepts taught using SC technology, and average proficiency of the concepts taught

using TC technology at each site. Results of the perception survey questions were grouped by type of technology used that day, TC or SC, and an average perception score between 1 and 5 was calculated for each question.

The one hundred and fifty-one subjects came from families that ranged from very low income to extremely affluent, and had varied levels of exposure to a variety of types of technology. The study went beyond simply looking at the integration of technology versus the absence of it in the classroom. Instead, the researchers analyzed which method of technology integration was the most beneficial to student performance: teacher-centered or student-centered. TC technology refers to any tool used by the teacher to help present information to the students. In contrast, SC technology refers to any form of technology that the students are using or manipulating in order to help them learn or understand a concept. The study did not focus on the types of technology used, but rather the method and effects of integration of various technologies on student performance. The question we sought to answer through this study was: To what extent would student-verses teacher-centered technology affect student performance?

Research Site A was in a rural community southwest of a major metropolitan area. The class consisted of 35 students that ranged in age from 14 to 15 years old. The class consisted of 23 males and 12 females. The students primarily came from middle class families within a 10-mile radius of the school. Of the 35 students in the class, 14 failed the previous semester. Student motivation was the greatest challenge in teaching this group of students.

Students were observed as on task when in class but were not motivated to complete any work outside of the class period. Many students turned in work that was rushed or incomplete. Another challenge for this class was to increase attendance in the students who were often absent. Students with high absence rates were missing much of the instructional time and were forced to understand a concept with limited instruction.

Implementation of technology into the classroom posed challenges. The school was limited in the amount of technology available for integration. Many of the resources available were tools students had used often such as PowerPoint, the Internet and computers. Due to the size of the class having enough resources was difficult and would require many of the integration activities to be done with either a partner or in a small group setting.

Site B included two general chemistry classes, "Chem A," and "Chem B." Chem A was the first trimester of this course, and Chem B was the second. Chem A consisted of 31 students, with a gender ratio of 15 males to 16 females. Ten students were sophomores, 19 were juniors, and two were seniors. Chem B consisted of 32 students, with a gender ratio of 13 males to 19 females. Thirteen students were sophomores and 19 were juniors. The majority of students at this site were highly motivated and the technology available was extensive. The resources that were available and the environment made this an ideal location for this study to take place.

At Site C there were six seniors, 18 juniors and one sophomore enrolled in the retake course of life science. The class consisted of 43% females and 57% males. The vast

majority of these students came from lower-middle class to poverty level in regards to socio-economic status. However, most of the students had cell phones, music devices and were generally experienced with technology. Students were reluctant to try new things and were often hard to motivate. The class was also the last period of the day, which added to the lack of focus. Technology available included a mounted digital projector and SMART Board, 20 digital cameras and 17 netbooks, a computer lab and mobile laptop computers.

In Site D the health class had 28 total students, 12 males and 16 females. Most of the students ranged in age from 15 to 16 years. Technologically, the classroom was equipped with a digital projector, a document camera, a VCR/DVD player, and speakers for instruction. Students came from a wide socio-economic range, where most fell toward the lower end. Despite this situation, many students had cell phones and other personal electronic devices, as was the case at other research sites. Students were accustomed to the use of the digital projector and the document camera as tools in the classroom.

### **Data Collection**

This study used three sets of data collection tools, which were administered in written form. Each researcher gathered the data at their assigned site. The first collection was baseline data, and was gathered through a survey composed of both closed-response and open-ended questions. The survey had seven questions which were designed to show the types of technology students and teachers had used, what students would like to see used more often in the classroom, and finally, the types of technologies students believed were most and least beneficial to their learning. The research team developed all surveys, and the same tools were used at each site.

The second data collection consisted of a Likert-style rating scale comprised of four questions and was designed to measure student perception of meeting the lesson's objective, understanding of the material, performance during class, and whether they felt that the use of technology helped them understand the material. Over the course of two weeks, this rating scale was distributed after TC technology lessons, and after SC technology lessons, for a total of four times at each site. This allowed for comparison of students' perceptions of their performance on SC versus TC technology lessons.

The third data collection was a student assessment. Because the content taught at each location during this study varied extensively, different student assessments were used. These student assessments were scored by the researcher at each site and included concepts that were taught on both TC and SC technology integration days. This data allowed for the comparison of objective assessment data against the subjective student perception of performance as indicated in the perception survey.

Once the initial baseline data was gathered, the information was analyzed and we began implementing both TC and SC technologies that students believed were beneficial to their learning. The second round of data collection was the student perception rating scale following each integrated lesson. Lastly, we scored the assessments. Because only certain types of technologies were available at each site, we were limited as to what was

available to use. Technology which students believed was most beneficial was used whenever possible.

After data collection, all data were combined and analyzed. We coded the responses based on which types of technologies students felt were most beneficial to their learning. After integrating these technologies into the classroom, our interest focused on student response about the technology that was SC versus TC. Finally, we focused on how this student perception compared to assessment of performance.

The goal of this study was to find which type of technology integration method, teacher-centered or student-centered, increased student performance. If the conclusion only relied on student perception of performance, it would not have been a comprehensive study. By completing a triangulation, including assessment of performance, we could compare what students felt was most beneficial and what teachers found to be effective based on assessments. This gave us a stronger basis from which to form conclusions.

### **Limitations**

There were limitations to this study, which included many variables that were uncontrollable. Results could have been influenced by students' own personal familiarity with technology and their own opinions. Participants came into this study with a specific technological language that could have influenced the results. Another limitation of this study was that the majority of data collection was through closed-response questioning. This type of questioning could be considered controlling because students were only given specific options. The process could have been improved by giving participants of the study more options for free-write responses to collect a wider range of data and potentially address limitations caused by closed-responses.

It is vital in research that the data collected throughout the course of a study be accurate, consistent, and substantial. A great deal of effort was put forth to ensure the methods used to obtain data throughout this study adhered to all three of these standards. Research was triangulated so as to ensure accuracy and legitimacy. Although research was collected from four different sites, the data was collected using standardized measurement tools. In order to ensure findings were reliable, one hundred and fifty-one students provided data, which was collected and analyzed to determine general trends.

### **Results**

The results of Site A showed that days with the integration of student-centered (SC) technologies led to higher perceptions of learning as well as increased accuracy on assessments. Students were able to accurately recall 69% of the content learned on teacher-centered (TC) technology days as compared to answering 81.5% of questions correctly relating to content that was presented on SC technology integration days.

On the list of the top three "most beneficial to learning" technologies, according to student survey, the most popular answer was PowerPoint. After the implementation of this TC technology at Site A, students correctly answered 73% of the assessment questions. The second technology on the list of most beneficial was Internet resources. When using a SC form of Internet for research students later scored 93% on the



assessment of that content. When the Internet was used for a virtual fieldtrip, also SC, the students later scored 70% on questions regarding that content leading to an average score of 81.5% on days Internet resource technology was integrated. It appears that the students at Site A believed PowerPoint to be the most effective technology; however, on average the Internet showed to be more effective in accurate recall of information and concepts. Interestingly, in a study done by Tang and Austin (2009), researchers found that students perceived video as having the highest amount of enjoyment, PowerPoint providing the highest amount of learning and motivation, and Internet providing the highest career application for future jobs. This may have been why these technologies were top choices for participants.

As a general trend within Site B, participants showed an increased perception of learning gains after SC technology integration when compared to TC technology integration. Assessments showed that students were able to perform at a higher level on material that was presented on SC days (84.1% accuracy) versus TC days (77.9% accuracy). However, students did not perceive that the technology itself helped them perform better. In fact, based on survey results, an average of 97% of participants said that TC technologies helped them understand the material more effectively, while only 90.5% reported that TC technologies were beneficial. The technology used at Site B included Word, PowerPoint, a document camera, computers, and lab equipment. Teacher-centered technologies used included Word, PowerPoint and a document camera for distributing notes. Students utilized computers for online research and digital balances for a lab activity on SC days.

At Site C, data on the first TC day was collected following a lesson that included direct instruction on cellular transport using a PowerPoint presentation. The second TC day allowed data to be collected based on the use of SMART Board and Notebook 10 software from a lesson on cell organelles. SC technology data from the first set was collected following a lesson where students used netbook computers to progress through an online workshop that focused on macromolecules. The second SC technology use data was followed by the use of microscopes to analyze water samples for microscopic organisms. The combined results of student perceptions on technology use seemed to favor TC technology. These results, however, are over-shadowed by the fact that SC technology produced consistently higher results on assessment scores. Additionally, students overwhelmingly felt that SC technology helped them learn the material more effectively.

Students at Site D performed better on days when SC technology was used as a part of instruction. When Classroom Performance Response System (CPS) technology was used, students performed 19% higher, scoring on average of 87% when compared to the first TC day in which students scored an average of 68% on an assessment over the material. When surveyed regarding their perception of performance, students at Site D rated themselves as performing better on days in which the technology use was SC. This perception on behalf of the students proved to be correct when they were assessed on material. The average score achieved by students on assessments of SC days was 92%, while the average score of students on assessments of TC days was 80%. When PowerPoint was used on the two TC days, students scored an average of 80% on

assessments. The first SC instruction was with the use of CPS and student assessments averaged at 87%. On the second SC day, in which students used online note taking, students averaged 97% on the assessment.

Baseline survey results showed that across all schools the top three technologies used by students were Microsoft Word, Internet resources and PowerPoint; these same three technologies were also seen as the most beneficial to student learning. The top three technologies used by teachers in the classroom were PowerPoint, movies and DVDs, and Microsoft Word; again these same three were indicated as the most beneficial to student learning through TC technology. Interestingly, the technologies suggested most often by students which were perceived to be beneficial to their learning included PowerPoint, movies and DVDs, Internet resources and SMART Boards (Tang & Austin, 2009).

Across all of the sites, the students' perception of performance or comprehension based on the technology in use was relatively high. Their perception of TC technology was greater than it was for SC technology only in Site C. Conversely, in the remaining sites students perceived SC technology to be a greater asset to their learning. The average result of student perceptions across all schools indicated that TC technology was slightly higher than SC technology. While the results are not significantly different between schools, within schools or among all schools, the students consistently believed that the SC technology helped their understanding of the material more effectively than TC technology. Previous research found that different instructional approaches led to significant differences in students' performance on achievement tests (Hui *et al.*, 2008). These findings substantiate our own results. Throughout the four sites in this study, different technological methods (instructional approaches) were used, and data show that participants performed at a higher level on assessment of material that was presented on student-centered instructional days, as opposed to teacher-centered days.

Although data from each site are similar in terms of student perception and actual student performance, the variations in results are due to many factors. First, each of the four sites had a different teacher with a specific teaching style and distinct relationship with their students. Second, the content being taught during data collection periods had varied levels of difficulty and contexts. Third, the socio-economic backgrounds of the schools are highly variable and could have affected the results. Last, the students possess individual characteristics. These factors play a significant role in contextualizing the information gained from our data collection. For example, at Site C, the majority of the students took this particular course for the second time. These low performing students may look more toward the teacher for their learning and may not have mastered learning strategies of their own. As a result, TC technology use was perceived as more helpful to their learning. Similarly, several studies showed that students under a learner-controlled environment performed more poorly on cognitive tasks than on other controlled situations, such as those that were teacher-directed (Chang, 2003). This, however, is contradictory to the fact that these very same students from Site C consistently scored higher on the assessments following SC technology use. In contrast, the students involved from Site A may have been more independent from having grown up using technology in their classroom and ranged from average to high performing.

Analysis of this study shows that students perform at a higher level when they are able to control technologies. With this known, further comparative research could be performed examining SC technology integration by focusing on a broader range of tools. Our study used technologies which students felt were beneficial to their learning, but future examination could be done to explore which SC technologies educators believe are helpful in increasing performance on cognitive and assessment activities. By examining a variety of technologies, we can identify the tools that are most beneficial to learning and construct lessons that increase student performance.

### Discussion

The findings of the study strongly impact instruction in American schools due to the fact that methods of technology integration result in significant differences on student achievement. Each site found student performance was higher on days in which instructional technologies were aimed at students use. With pressure on administrators to develop schools where students are consistently increasing their levels of proficiency, these findings are encouraging. These data must be taken into account when classroom teachers are preparing lessons. Ramaley and Zia write, “interactive technologies enrich traditional forms of learning and serve as links between active and passive, individual and group, and transmission and generation of knowledge” (Brown, 2005 p. 142). We found that SC technology benefits students; administrators must encourage and support educators in putting this knowledge into practice. As an administrator, it would be beneficial to ensure classroom teachers understand the importance and impact of SC technology use, are trained in how to use technology in a SC manner, and have the tools to create lessons involving SC technology integration.

Although this study found the use of SC technology enhances student performance, preparation for instruction is imperative. Nystrand and Gamoran (1991) found activities involving technology integration must be well designed and have explicit learning targets in order to benefit student comprehension. We found when the use of technology is not seamlessly integrated into the lesson the positive benefits are not attained. Just because technology is integrated does not necessarily mean learning has been enriched. For administrators, it is essential to ensure that classroom teachers are fully trained on the use and integration of technology with a student-centered focus. Almost all types of technology can be used in a student-centered way. However, it is necessary to ensure adequate training takes place for teachers via in-service workshops, professional development days, etc. so technology is not merely used in the classroom, but used effectively. In addition, administrators should observe classrooms to ensure student-centered technological integration is taking place to produce increased student proficiency on concepts.

In this study, reliability of technology was found to be a significant factor in student perception of effectiveness. Issues with technology at Sites B and C affected the way students perceived the lesson, but did not necessarily influence how students performed on assessments. Despite the potential for a given technology to affect student performance, the actual impact may vary depending on any number of factors. Technology being prepared and in good working condition is never a given, but is often times an expectation. When such assumptions occur, there may be negative

effects. Communicating with school media specialists should be a priority. If teachers are unable to integrate technology due to faulty equipment, students do not reap the benefits, and their learning is perhaps even hindered by distraction. Administrators must partner with school media specialists to ensure technology is readily available and in working order.

Administrators aim to shape their schools in ways that will benefit students. Therefore, use of the present findings must be implemented to increase effectiveness of instruction. The use of technological tools by students can further their understandings and allow them to make greater connections with material. However, as has been discussed, there are many factors, which can contribute to the effectiveness of any given technology, as well as student perception of effectiveness.

It is important to note that numerous technological tools were used in this study. Availability of technological resources can vary greatly, as was the case in this research. Despite the particular technology that was used, student performance was higher when the technologies were centered on student use. Similar results were observed by Wu and Huang (2006), who found that students in a SC class reported having significantly higher emotional engagement. Therefore, the findings of this study have implications for all schools. No matter the technology available, schools have the ability to use technologies through SC application, which in turn, will increase student performance as measured through assessments, and enhance the educational experiences of students.

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